Saskatchewan
Agriculture, Food
and Rural
Revitalization

ADF

AGRICULTURE DEVELOPMENT FUND

FINAL REPORT

19970241

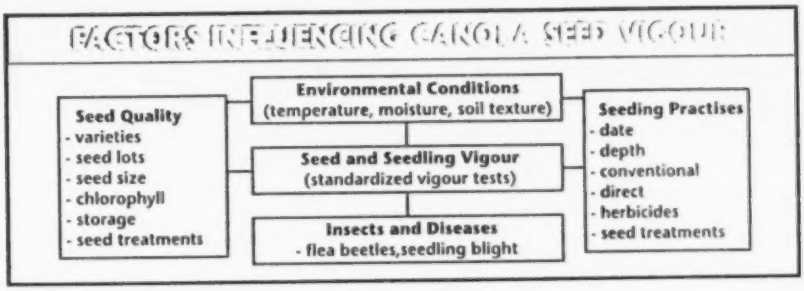
FACTORS LIMITING GERMINATION, EMERGENCE AND VIGOUR OF CANOLA

Funded by:
The Agriculture Development Fund

August 2001
Prepared by: Agriculture and Agri-Food Canada

Factors that Affect Canola Germination, Seed and Seedling Vigour

Germination, seed and seedling vigour are affected by many factors, including environmental conditions, seeding practises, insects and diseases. This fact sheet describes some key factors that growers should consider when growing canola. A separate fact sheet, *Using Canola Seed Vigour Tests*, outlines the tests used to determine germination, vigour and seed quality.



Making informed seed purchases and good seeding decisions requires a basic understanding of seeding practises, pest problems and seed quality.

Cultural Factors

Growers can make decisions on which cultural practises to use. The practises related to germination and vigour can include the time of seeding, seeding depth and seed treatments.

Time of Seeding

Soil temperature and time of seeding are highly correlated — as seeding time gets later, soil temperature increases. Higher soil temperatures generally lead to faster emergence, better establishment and better plant growth (Table 1). Field studies between 1998 and 2000 indicated that late seeding (May 24 – 30) improved seedling establishment by 14% compared to early seeding (May 5 – 13). However, early seeding resulted in higher yields.

Table 1. Establishment and Yield of *Brassica napus* Canola in Early and Late May Seeding*

Planting Date	Seedling Est. (%)**	Seed Yield (bu/ac)
Early May	40	42.8
Late May	54	37.5

*Early seeding (May 5 – 13), late seeding (May 24 – 30)

**Establishment 21 days after seeding

Although late seeding does improve emergence and growth (due to warmer soils), numerous studies have shown the yield benefits of early seeding (Table 2). Early seeded canola takes advantage of spring moisture. The crop often begins and completes flowering before what is generally the hottest part of the year in western Canada, and usually results in higher yields. In 65% of tests conducted between 1998 and 2000, yields were significantly higher when canola was seeded in early May rather than late May.

Table 2. Percentage of Tests Comparing Performance of Early and Late May Seeding*

Seedling	Establishment (%)	Seed Yield (%)
Early = late	22	6
Early > late	13	65
Late > early	65	29

*Early seeding (May 5 – 13), late May seeding (May 24 – 30)

Seeding Depth

Research conducted between 1998 and 2000 found no significant difference in flea beetle damage for seed lots planted 2 cm and 4 cm deep (0.75" to 1.6"). In addition, no significant difference was found in the number of seedlings per row, fresh weight, biomass or seed yield. The effects of seeding depth on agronomic performance varied significantly depending on year (moisture), seed lot and seed size. However, in years characterized by cold air and soil temperatures or any condition that does not favour rapid germination or establishment, seeding depth is important. When adverse conditions slow the rate of germination and emergence, seeds placed too deep must use more of their reserves to emerge and may not establish. Numerous other research studies have concluded that the most effective canola seeding depth is between 1.2 cm and 2.5 cm (½" to 1").

Seed Treatments

Some seed lots treated for an extended period may have reduced germination and vigour. Research is being conducted to determine the effect of storage conditions and storage time on vigour of seed lots treated with different registered seed treatments. Until these effects are determined, conduct a germination or vigour test three to four months prior to seeding.

Pest Related Factors

Several pests can affect germination, seed and seedling vigour, in particular, flea beetles and fungal diseases.

Flea Beetles

When flea beetle damage occurs, high germination lots have higher seedling counts in the field, better seedling growth and lower damage than low germination seed lots.

Fungal Diseases

Some seed-borne fungal diseases can affect germination and emergence. A complex of several soil-borne pathogens cause the diseases seedling blight and damping off, which generally affect the seed, hypocotyl and root. If affected, seeds can fail to germinate, fail to emerge or the seedling roots can decay causing wilting and retarded growth.

Seed Quality Factors

Seed quality factors are very important, because other than purchasing decisions, the grower has no control over a poor quality seed lot. Although management can account for minor discrepancies in cultural and pest related factors, a poor quality seed lot is a poor quality seed lot regardless of what the grower does. When purchasing certified seed, the grower must realize the importance of seed quality and ask the appropriate questions of the seed supplier. Seed quality factors include seed maturity, seed size, chlorophyll content and genetics.

Seed Maturity

Optimum growing conditions at maturity include:

- adequate fertility
- moisture
- temperature
- correct time of swathing

These conditions tend to produce high quality seed lots. Large, plump, fully matured seeds have the potential to provide superior germination, seedling establishment and growth. Factors that can affect seed maturity and reduce seed quality include:

- frost
- insect or disease damage
- drought stress
- early swathing

The seed supplier may not be able to provide exact details on the growing conditions and management factors that can affect seed. However, examining seed characteristics will help. Characteristics of high quality seed include:

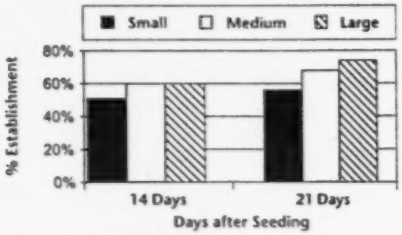
- a low green seed count
- large seed or high seed weight
- high germination (above 90%) at seven days

Seed Size

Research has shown that seed size can affect seedling establishment, growth and yield. Seeds originating from the same seed lot were fractioned into three seed size classes, including small seed (1.40 – 1.60 mm), medium seed (1.60 – 1.80 mm) and large seed (1.80 – 2.00 mm).

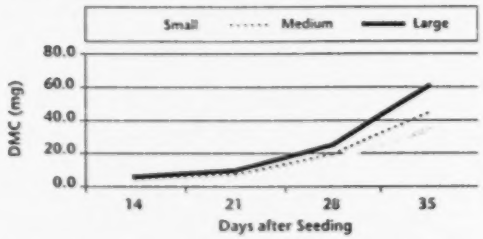
Researchers tested sized seeds for flea beetle damage, dry matter content (a component of seedling vigour) and seed yield. Large seed had better establishment than medium or small seed from the same seed lot (Figure 1). Large seed also produced the largest seedlings. Large cotyledons buffered the effects of flea beetle feeding and reduced damage. At 21 days, seedlings grown from large seed had 5% less feeding damage than seedlings grown from small seed.

Figure 1. Establishment of *B. napus* Canola Grown from Small, Medium and Large Seed



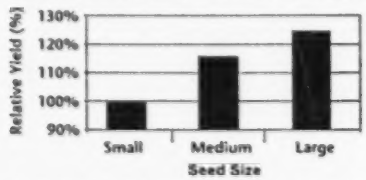
Dry matter content (DMC) is a component of seedling vigour. Dry matter accumulation is an important factor in seed yield and tolerance of plants to insect, weed and disease stress. Faster DMC accumulation means faster growth, which allows plants to better tolerate many stresses. Figure 2 illustrates DMC in milligrams. Note the relative difference between the seed size categories. At 35 days, the DMC of plants grown from large seeds was almost twice that of plants grown from small seeds.

Figure 2. Dry Matter Content (DMC) of *B. napus* Canola Grown from Small, Medium or Large Seed



Seed size, within a lot, can also affect seed yield. Research showed that small seed yielded 19% less than large seed of the same seed lot. The overall effect of seed size on yield potential would be determined by the percentage of each seed size in the lot.

Figure 3. Seed Yield of *B. napus* Canola Grown from Small, Medium or Large Seed



Consider seed size when buying seed and if possible choose a seed lot with large, plump seed and high seed weight. Data in Table 3 can be used to select lots.

Table 3. Approximate Seed Diameter, Screen Size and Associated 1,000-Seed Weights in *B. rapa* and *B. napus* Canola

Seed Diameter (mm)	Screen Size (/64")	1,000-Seed Weight (g)	
		B. rapa	*B. napus*
<1.40	3.5	1.0 – 1.2	–
Small (1.40 – 1.59)	4.0	1.7 – 2.3	1.5 – 2.2
Medium (1.60 –1.79)	4.5	2.5 – 2.9	2.7 – 3.0
Large (1.80 – 1.98)	5.0	3.1 – 3.5	3.0 – 3.6
1.99 – 2.18	5.5	–	3.9 – 4.4
2.19 – 2.38	6.0	–	4.9 – 5.3
>2.38	6.5	–	6.3 – 6.7

Chlorophyll Content

Medium to very high chlorophyll content can result in:

- lower germination
- poor seedling emergence
- lower dry matter content
- higher flea beetle feeding damage
- reduced yield

Researchers produced the seed lots referenced in Table 4 in a prior swathing experiment. The seed lots were stored at 8% moisture at -15°C.

Table 4. Chlorophyll Content of Seed Lots Tested

Seed lot	Chlorophyll (mg/kg)	1,000-Seed Weight(g)
Very low	6.5	2.6
Low	24.0	3.0
Medium	45.0	2.0
Very high	70.5	2.1

Medium to very high chlorophyll seed lots had the poorest seedling establishment (Figure 4) and lowest dry matter content (Figure 5).

Figure 4. Establishment of *B. napus* Canola Seed Lots with different Chlorophyll Contents

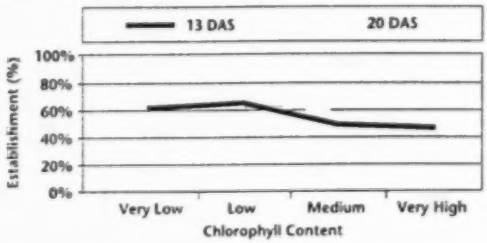
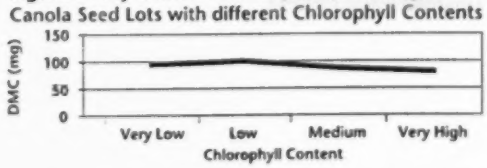


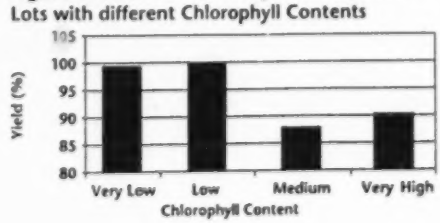
Figure 5. Dry Matter Content (DMC) of *B. napus* Canola Seed Lots with different Chlorophyll Contents



Flea beetle damage to seedlings was 5% lower with very low chlorophyll seed lots than with very high chlorophyll lots.

Seed lots with medium or very high chlorophyll had lower yields than seed lots with very low or low chlorophyll (Figure 6). However, in this study, seed lots with medium or very high chlorophyll also had the lowest seed weights.

Figure 6. Seed Yield of *B. napus* Canola Seed Lots with different Chlorophyll Contents



When purchasing seed, ensure a low green seed count, even if the germination and vigour ratings are adequate. Table 5 illustrates the relationship between chlorophyll (in mg/kg) in green seed (also referred to as parts per million or PPM) and green seed as a per cent of total seed. Generally, every 10 mg/kg of chlorophyll equates to approximately 1% green seed.

Table 5. Relationship between Chlorophyll Content and Green Seed

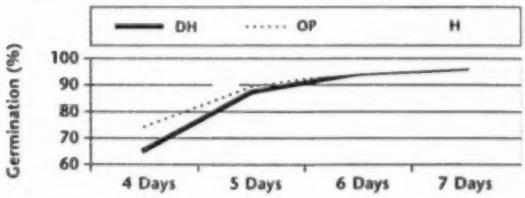
Grade	Chlorophyll (mg/kg)	Green Seed (%)
No. 1	< 25	< 2
No. 2	26 – 45	2 – 6
No. 3	56 – 100	6 – 20

Genetics

Genetics play an important role in germination, seed and seedling vigour. The studies referenced in this fact sheet did not test all canola varieties, therefore, no specific recommendations are made. Researchers examined several breeding types of canola, including hybrids (H), open pollinated (OP) and doubled haploid (DH) varieties. DH and OP varieties are similar, but are developed by different breeding techniques. The method of breeding may affect the rate of germination, dry matter content and yield.

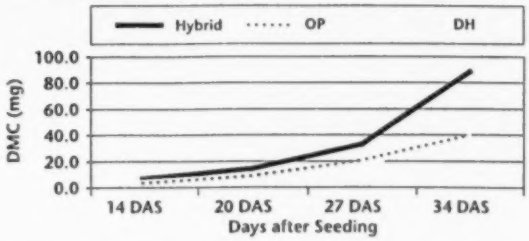
Of the varieties tested, hybrids germinated faster than OP's, which in turn germinated faster than DH varieties. However, the per cent germination of the three breeding types was similar after seven days (Figure 7).

Figure 7. Germination of different Breeding Types of *B. napus* Canola



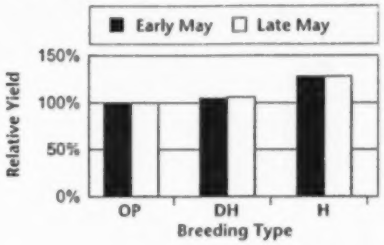
Dry matter content also differed among breeding types (Figure 8). Dry matter was higher in hybrid varieties than OP or DH varieties.

Figure 8. Dry Matter Content (DMC) of different Breeding Types of *B. napus* Canola



Hybrid varieties with high seed weight had higher yields than OP or DH varieties with low seed weights (Figure 9).

Figure 9. Relative Seed Yield of different Breeding Types of *B. napus* Canola Seeded in Early May and Late May



When purchasing seed, consider the following varietal traits:

- herbicide tolerance
- yield
- lodging
- disease resistance

Consider these characteristics in conjunction with the role genetics plays in germination, seed and seedling vigour.

Conclusion

Germination, seed and seedling vigour are complex issues influenced by many factors. A grower can control to some extent many cultural and pest management factors. However, the most important consideration in a seed purchase from a germination, seed and seedling vigour standpoint, is seed quality. Seed quality is important because the grower cannot change management practices to accommodate for deficiencies in a seed lot. Be aware of seed quality and make informed decisions based on the relationship with the seed supplier and an understanding of germination and vigour testing.

These organizations wish to thank Dr. Bob Elliott, Research Scientist, Agriculture and Agri-Food Canada Research Centre, Saskatoon, for his research on seed and seedling vigour and for his input into this publication. The research was funded by growers, seed testing laboratories, Agriculture and Agri-Food Canada, Saskatchewan Agriculture, Food and Rural Revitalization – Agriculture Development Fund and the seed industry.

For further information, contact your Canola Council agronomist,
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